ELECTRONIC INNOVATION Inc.

User Manual

DeviceNet™

6 High Current Pulse Width Modulated (PWM) Channel,
2 Voltage Output Channel Analog Output Module

"DN" - Harsh Environment Series

Model DN004

Electronic Innovation Inc.
1130 Webbwood Dr., Unit A
Sudbury, Ontario
Canada
P3C 3B7

Phone: (705) 673-9404
Fax: (705) 673-3811
email: info@ElectronicInnovation.ca

Document Type:	User Manual
Document Title:	*DeviceNet*™ High Current Pulse Width Modulated (PWM) Analog Output Module
Module Model:	DN004
Document Number:	DN004-UM1-D2.0
Document Revision:	2.0
Document Status:	Released

Document Revision History

Date	Release No.	Notes
April 25, 2000	DN004-UM-D1.0	First document release in draft form for review and comments.
August 14, 2000	DN004-UM-D2.0	Second draft

Disclaimer of Warranties and Limitations of Liability

Electronic Innovation Inc. prepared the following documentation. While the authors and developers have taken reasonable care in preparing this documentation, Electronic Innovation Inc. assumes no liability resulting from any inaccuracy or omission contained herein.

The information in this document is for reference only, and can change at any time without notice. Electronic Innovation Inc. in no event shall be liable for incidental or consequential damages in connection with or arising out of the delivery of or use of this product or documentation.

ELECTRONIC INNOVATION Inc.

1130 Webbwood Dr., Unit A
Sudbury, Ontario
Canada
P3C 3B7

Trademarks

- *DeviceNet* is a trademark of the Open DeviceNet Vendors Association

Statement of Limited Product Warranty

ELECTRONIC INNOVATION INC. ("EII") warrants that all parts and components of the modules or other devices ("Products") manufactured by EII shall be free from defects in materials and workmanship under normal use for a period of one year, or 2000 hours of service, whichever elapses first, from the earlier of the commissioning/installation date or the date of first use. EII's warranty shall be limited to the repair, replacement or adjustment of such defective parts during the warranty period.

EII assigns to its customers the full benefit of all original equipment manufacturers' warranties for non-EII sub components found in Products.

EII warranty does not apply if the product has been damaged by accident, abuse, misuse, misapplication or neglect, or as a result of service, disassembly or modification without EII's express authorization.

Notification of defective parts must be forwarded in writing immediately to EII's nearest service depot and such defective parts must be shipped by customer to EII's nearest service depot for warranty analysis. A reasonable period of time shall be allowed to perform warranty assessment and repair and/or replace any defective parts. Notification to customer of parts and/or repairs deemed by EII as not covered by this limited warranty shall be provided promptly.

EII is not responsible for mileage, travel expenses, travel time, overtime labour and or any freight expenses required to facilitate the repair.

The limited warranty provided herein is non-transferable and is contingent on the proper use of the Products during the warranty coverage period. The limited warranty provided herein is in lieu of all other warranties or conditions, express or implied, including, but not limited to, the implied warranties or conditions of merchantable quality and fitness for a particular purpose and those arising by statute or otherwise in law or from a course of dealing or usage of trade. No oral or written information or advice given by EII, its dealers, distributors, agents or employees shall create a warranty or in any way increase the scope of this warranty and the customer may not rely on any such information or advice.

The liability of EII, its directors, officers, employees and agents, if any, for damages relating to any defective or allegedly defective Products or component thereof shall under any legal theory be limited to the actual price paid for the Products and in no event include any incidental, consequential, special or indirect damages of any kind, nor damages for any injury, loss of life, loss of use, revenue or profit or failure to realize expected savings or for other economic loss, even if EII shall have been advised of the possibility of such potential loss or damage.

Table of Contents

Module Description 5

Module Configuration 5

Module Operation 6

Module Calibration 7

Appendix A: Statement of Compliance 8

Appendix B: Electronic Data Sheet (EDS) Listing 17

Appendix C: Specifications 21

Appendix D: Mechanical Drawings 23

1. Module Description

The Electronic Innovation Inc. “DN” line of modules are intended to provide rugged, reliable, *DeviceNet*™ I/O capability in unusually harsh environments. These include applications such as on-board control of heavy underground mobile mining equipment or armoured military vehicles.

The DN line has been designed from the ground up to survive these environments with special attention in the following areas:

a) Mechanical design for high shock, vibration, and concussion tolerance, resistance to liquids such as water or oil, and most forms of corrosion, along with wide operating temperatures.
b) Electrical design to exceed Mil-Spec. standard reliable operation in the face of severe electrical transients such as the load-dump transient which can occur on heavy vehicle electrical systems.
c) Electronic design to minimize electromagnetic emissions and provide low susceptibility to external electromagnetic interference.
d) Extensive design effort has been expended to ensure that hardware, software, or network faults, if and when they occur, will result in a predictable and timely transition of the module to the safest achievable state.

The DN004 *DeviceNet*™ High Current Pulse Width Modulated (PWM) and Voltage Analog Output Module provides six outputs which are well suited to provide high-side control of heavy inductive vehicle loads such as the solenoids used for proportional electric control over hydraulic systems. The duty cycle of these outputs may be varied from true 0% to true 100% allowing them to also be used as discrete digital outputs. The wide PWM frequency range available permits operation with a range of available equipment from many manufacturers. The DN004 also provides two protected voltage output channels with a maximum span of –10V to +10V. These are often used for such purposes as providing the control input to servo positioning systems or the throttle input for electronic engine controls.

2. Module Configuration

The DN004 module must be configured for proper operation on the DeviceNet network. This module operates as a Group 2 Only Server, UCMM Incapable Device, and therefore communicates using the Predefined Master/Slave Connection Set. Supported message types include I/O Poll, and Explicit. Change of State, Cyclic, and Bit Strobe message types are not supported in this version of the DN004.

The baud rate and MAC ID may need to be changed from their default shipping values before the module will operate properly on the target network. For the DN004, the only way to change these values is with software using any DeviceNet

compliant configuration tool capable of allocating the module and accessing its attributes.

The characteristics of the eight outputs may be changed as well using the same or similar tool. The most common characteristics are the frequency of the PWM output signal and the range of the analog outputs. These should be set individually to match the requirements of the equipment being driven by the output.

All of the above configurations, when changed, are automatically stored in a non-volatile EEPROM. The configuration of the module is not lost when the module is powered down, or, if the module undergoes a reset.

3. Module Operation

Once configured, the DN004 is ready to start driving output loads in response to data sent from the master.

The master can drive an output using either I/O Poll, or Explicit message types. These message types are described below.

3.1 I/O Poll Messages

The master issues I/O Poll Request messages to the DN004. The data portion of these messages contains the values destined for each output channel in ascending channel order. All data channels are contained in every I/O poll message. There is one byte per output channel resulting in the following 8 byte data format:

1	2	3	4	5	6	7	8
CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8

where the value of CHx is a number between 0 and 255 (FF_{HEX}). For channels 1, 2, 3 ,4, 7 and 8 the duty cycle of the PWM output signal is given by the following equation:

Duty Cycle = CHx/255 , x = 1, 2, 5, 6, 7, 8

Examples:

CH1 = 0	gives	Duty Cycle 1 = 0%	(output completely off)
CH7 = 255	gives	Duty Cycle 7 = 100%	(output completely on)
CH2 = 127	gives	Duty Cycle 3 = 50%	

For outputs 3 and 4, the output voltage depends on the CHx value and the set output range. The following table relates the range and CHx value to the output voltage.

Range	CHx Values	Formula
0 to 10V	0 to 255 (0x00 to 0xFF)	(CHx / 255) * 10
-10 to 10V	0 to 127 (0x00 to 0x7F)	(CHx / 127) * 10
	-128 to –1 (0x80 to 0xFF)	(CHx / 128) * 10
0 to 5V	0 to 255 (0x00 to 0xFF)	(CHx / 255) * 5
-5 to 5V	0 to 127 (0x00 to 0x7F)	(CHx / 127) * 5
	-128 to –1 (0x80 to 0xFF)	(CHx / 128) * 5

3.2 Explicit Messages

The master can also set the value of each output individually by setting attribute 3 (Value) of the corresponding AOP object.

The output frequency may be configured by setting attribute 100 (PWM Frequency) of the corresponding AOP object while the analog output range may be configured through attibute 101 (Analog Output Range).

4 Module Calibration

There are no PWM calibrations required for the DN004. The basic PWM frequency is guaranteed to drift by less than 100 ppm over the life of the unit.

The voltage outputs on the DN004 module are shipped fully calibrated. Should calibration be lost, the DN004 should be returned to the factory for inspection and recalibration.

Appendix A: Statement of Compliance

A.1 General Device Data

Conforms to DeviceNet Specification	Volume I, Release 2.0 Volume II, Release 2.0
Vendor Name	Electronic Innovation Inc.
Device Profile Name	Generic Device
Product Catalog Number	DN004
Product Revision	Hardware Ver. 1.4 Software Ver. 2.1

A.2 DeviceNet Physical Conformance Data

Max. Network Power Consumption	0.15A @ 11 VDC (worst case)
Connector Style	
DN004-OF	Open-Pluggable
DN004-SSE	Sealed-Mini
LED Supported	Combo Mod/Net Status
MAC ID Setting	Software Selectable
Default MAC ID	63
Communication Rate Setting	Software Selectable
Communication Rates Supported	125 kbps, 250 kbps, 500 kbps

A.3 DeviceNet Communications Data

Predefined Master/Slave Connection Set	Supported, Group 2 Only Server
Dynamic Connections Supported (UCMM)	None
Fragmented Explicit Messaging Supported	No

A.4 DeviceNet Information

The DN004 operates as a slave device on a DeviceNet network. It supports Explicit Messages and Polled I/O Messages of the Predefined Master/Slave Connection Set. It does not support the Explicit Unconnected Message Manager (UCMM)

DeviceNet Message Types

As a Group 2 Slave device the DN004 supports the following incoming message types

CAN Identifier Field	Group 2 Message Type
10xxxxxx100	Master Explicit Request Message
10xxxxxx101	Master I/O Poll Command Message
10xxxxxx110	Group 2 Only Unconnected Explicit Request Message
10xxxxxx111	Duplicate MAC ID Check Messages

xxxxxx = DN004 Node Address (0..63)

DeviceNet Class Services

As a Group 2 Slave device, the DN004 module supports the following class and instance services.

Service Code	Service Name
0x05 HEX	Reset
0x0E HEX	Get_Attribute_Single
0x10 HEX	Set_Attribute_Single
0x4B HEX	Allocate_Master/Slave_Connection_Set
0x4C HEX	Release_Master/Slave_Connection_Set

DeviceNet Object Classes

The DN004 module supports the following DeviceNet Object classes

Class Code	Service Name
0x01 HEX	Identity Object
0x02 HEX	Message Router Object
0x03 HEX	DeviceNet Object
0x04 HEX	Assembly Object
0x05 HEX	Connection Object
0x0B HEX	Analog Output Point Object

A.5 DeviceNet Required Object Implementation

Identity Object Class Code: 01_{HEX}

The Identity Object is required on all devices and provided identification and general information about the device.

Object Class

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Revision	UINT	1

Number of Instances: 1
Object Instance

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Vendor ID	UINT	285
2	Get	Device Type	UINT	0
3	Get	Product Code	UINT	4
4	Get	Revision Major Revision Minor Revision	STRUCT of: USINT USINT	 2 1
5	Get	Status	WORD	see DeviceNet Specification
6	Get	Serial Number	UDINT	32 bit serial number
7	Get	Product Name	SHORT_STRING	DN004

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
5 (05_{HEX})	No	Yes	Reset
14 ($0E_{HEX}$)	Yes	Yes	Get_Attribute_Single

Message Router Object Class Code: 02_{HEX}

The Message Router Object provides a messaging connection point through which a Client may address a service to any object class or instance residing in the physical device.

Object Class

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Revision	UINT	1

Number of Instances: 1
Object Instance

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
2	Get	Number of Connections	UINT	2

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
14 ($0E_{HEX}$)	Yes	Yes	Get_Attribute_Single

DeviceNet Object Class Code: 03_{HEX}

The DeviceNet Object is required on all devices and is used to provide the configuration and status of a physical attachment to DeviceNet.

Object Class

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Revision	UINT	2

Number of Instances: 1

Object Instance

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get/Set	MAC ID	USINT	0 to 63*
2	Get/Set	Data Rate	USINT	0* = 125 kbps 1 = 250 kbps 2 = 500 kbps
3	Get/Set	Bus-Off Interrupt (BOI)	BOOL	0* = Hold CAN chip in Bus off 1 = Reset CAN chip if possible
4	Get/Set	Bus-Off Counter	USINT	0 to 255
5	Get	Allocation Information Alloc. Choice Byte Master's MAC ID	STRUCT of: BYTE USINT	 Alloc. Choice Table Range 0..63, 255 255 = not allocated

*Factory default

Alloc. Choice Table

Bit	Service	Value
0	Explicit Message	Supported. Set to 1 to allocate
1	I/O Poll	Supported. Set to 1 to allocate
2	Bit Strobe	Not Supported. Always 0
3	-	Reserved. Always 0
4	Change of State	Not Supported. Always 0
5	Cyclic	Not Supported. Always 0
6	Acknowledge Suppression	Always 0
7	-	Reserved. Always 0

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
14 ($0E_{HEX}$)	Yes	Yes	Get_Attribute_Single
16 (10_{HEX})	No	Yes	Set_Attribute_Single
75 ($4B_{HEX}$)	No	Yes	Allocate_Master_Slave_Connection_Set
76 ($4C_{HEX}$)	No	Yes	Release_Master_Slave_Connection_Set

Assembly Object

Class Code: 04$_{HEX}$

The Assembly Object binds attributes of multiple objects which allows data to or from each object to be sent or received over a single connection.

Object Class

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Revision	UINT	2

Number of Instances: 1

Object Instance

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
3	Get	Data	BYTE Array	*Output Status Byte*

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
14 (0E$_{HEX}$)	Yes	Yes	Get_Attribute_Single

Connection Object Class Code: 05_{HEX}

The Connection Object manages the characteristics of each communication connection. As a Group 2 Only Slave device, the module supports one Explicit Message connection and one I/O Poll Message connection.

Object Class

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Revision	UINT	1

Number of Instances: 2
Object Instance 1 – Explicit Messaging

Attribute ID	Access Rulew2	Name	DeviceNet Data Type	Value
1	Get	State	USINT	0 = Non-existent 3 = Established 5 = Deferred Delete
2	Get	Instance Type	USINT	0 = Explicit Messaging
3	Get	Transport Class Trigger	BYTE	83_{HEX}
4	Get	Produced Connection ID	UINT	$10xxxxxx011_{BIN}$ xxxxxx = DN004 MAC ID
5	Get	Consumed Connection ID	UINT	$10xxxxxx100_{BIN}$ xxxxxx = DN004 MAC ID
6	Get	Initial Comm. Characteristics	BYTE	21_{HEX}
7	Get	Produced Connection Size	UINT	7
8	Get	Consumed Connection Size	UINT	7
9	Get/Set	Expected Packet Rate	UINT	2500 ms
12	Get/Set	Watchdog Timeout Action	USINT	1 (Auto Delete) 3 (Deferred Delete)
13	Get	Produced Connection Path Length	UINT	0
14	Get	Produced Connection Path	Array of USINT	Null (no data)
15	Get	Consumed Connection Path Length	UINT	0
16	Get	Consumed Connection Path	Array of USINT	Null (no data)
17	Get	Production Inhibit Time	UINT	0 (no inhibit time)

Object Instance 2 – I/O Poll

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	State	USINT	0 = Non-existent 1 = Configuring 3 = Established 4 = Timed Out
2	Get	Instance Type	USINT	1 = I/O Messaging
3	Get	Transport Class Trigger	BYTE	82_{HEX}
4	Get	Produced Connection ID	UINT	$01111xxxxxx_{BIN}$ xxxxxx = DN004 MAC ID
5	Get	Consumed Connection ID	UINT	$10xxxxxx101_{BIN}$ xxxxxx = DN004 MAC ID
6	Get	Initial Comm. Characteristics	BYTE	01_{HEX}
7	Get	Produced Connection Size	UINT	1
8	Get	Consumed Connection Size	UINT	8
9	Get/Set	Expected Packet Rate	UINT	200 ms
12	Get/Set	Watchdog Timeout Action	USINT	0* (Timeout) 1 (Auto Delete) 2 (Auto Reset)
13	Get	Produced Connection Path Length	UINT	6
14	Get	Produced Connection Path	Array of USINT	$\{20, 04, 24, 64, 30, 03\}_{HEX}$
15	Get	Consumed Connection Path Length	UINT	6
16	Get	Consumed Connection Path	Array of USINT	$\{20, 04, 24, 64, 30, 03\}_{HEX}$
17	Get	Production Inhibit Time	UINT	0 (no inhibit time)

*Factory default

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
5 (05_{HEX})	No	Yes	Reset
14 ($0E_{HEX}$)	Yes	Yes	Get_Attribute_Single
16 (10_{HEX})	No	Yes	Set_Attribute_Single

A.6 DeviceNet Open Object Implementation

Analog Output Point Object   Class Code: $0B_{HEX}$

The Analog Output Point (AOP) models the point level attributes and services of the analog outputs in the DN004.

Object Class

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
1	Get	Revision	UINT	1
2	Get	Max. Object Instance	UINT	8

Number of Instances: 8
Object Instances 1 to 8

Attribute ID	Access Rule	Name	DeviceNet Data Type	Value
3	Get/Set	Value	BYTE	Range 0..255
100	Get/Set	PWM Frequency	UINT	Range: 20..2500 (45*)
101	Get/Set	Analog Output Range	USINT	1 (0V to 10V) 3** (-10V to 10V) 4 (0V to 5V) 5 (-5V to 5V)
102	Get	PWM Output	BOOL	0** (Analog) 1* (PWM)

*Factory default for outputs 1, 2, 3, 4, 7, 8
**Factory default for outputs 5, 6

Common Services

Service Code	Implemented for:		Service Name
	Class	Instance	
14 ($0E_{HEX}$)	Yes	Yes	Get_Attribute_Single
16 (10_{HEX})	No	Yes	Set_Attribute_Single

Appendix B: Electronic Data Sheet (EDS) Listing

```
$ Electronic Innovation Inc.
$ DN004 - 6 PWM, 2 Analog Output Module - EDS


[File]
    DescText=   "DN004 EDS";
    CreateDate= 8-11-2000;
    CreateTime= 10:00:00;
    ModDate=    8-11-2000;
    ModTime=    10:00:00;
    Revision=   2.0;


[Device]
    VendCode=   285;
    ProdType=   0;
    ProdCode=   4;
    MajRev=     2;
    MinRev=     1;
    VendName=   "Electronic Innovation Inc.";
    ProdTypeStr="Generic Device";
    ProdName=   "DN004";
    Catalog=    "DN004";


[IO_Info]
    Default=    0x0001;
    PollInfo=   0x0001,1,1;

    Input1=     1,0,0x0001,"Producing IO/Data",6,"20 04 24 64 30 03","Poll Produced";
    Output1=    8,0,0x0001,"Consuming IO/Data",6,"20 04 24 64 30 03","Poll Consumed";


[ParamClass]
    MaxInst=24;
    Descriptor=0;
    CfgAssembly=0;


[Params]
    $ ------------------------------------------------------------------------------ $
    $                                 CHANNEL 1                                      $
    $ ------------------------------------------------------------------------------ $
    Param1=
       0,                            $ reserved
       6, "20 0B 24 1 30 3",         $ link size and path
       0x00,                         $ descriptor
       0xD1, 1,                      $ data type, data size (in bytes)
       "Value 1",                    $ parameter name
       "/255",                       $ units string
       "AOP Output Value",           $ help string
       0,255,0,                      $ minimum, maximum and default values
        , , , , , , , , ;            $ optional fields

    Param2=
       0,                            $ reserved
       6, "20 0B 24 1 30 64",        $ link size and path
       0x00,                         $ descriptor
       0xC7, 2,                      $ data type, data size (in bytes)
       "PWM Freq 1",                 $ parameter name
       "Hz",                         $ units string
       "PWM outputs only",           $ help string
       20,2500,45,                   $ minimum, maximum and default values
        , , , , , , , , ;            $ optional fields

    Param3=
```

```
   0,                          $ reserved
   6, "20 0B 24 1 30 65",      $ link size and path
   0x02,                       $ descriptor
   0xC6, 1,                    $ data type, data size (in bytes)
   "Analog Range 1",           $ parameter name
   "N/A",                      $ units string
   "Analog outputs only ('2' not supported)",       $ help string
   1,5,3,                      $ minimum, maximum and default values
    , , , , , , , , ;          $ optional fields

$ -------------------------------------------------------------------------------- $
$                                  CHANNEL 2                                       $
$ -------------------------------------------------------------------------------- $
Param4=
   0,                          $ reserved
   6, "20 0B 24 2 30 3",       $ link size and path
   0x00,                       $ descriptor
   0xD1, 1,                    $ data type, data size (in bytes)
   "Value 2",                  $ parameter name
   "/255",                     $ units string
   "AOP Output Value",         $ help string
   0,255,0,                    $ minimum, maximum and default values
    , , , , , , , , ;          $ optional fields

Param5=
   0,                          $ reserved
   6, "20 0B 24 2 30 64",      $ link size and path
   0x00,                       $ descriptor
   0xC7, 2,                    $ data type, data size (in bytes)
   "PWM Freq 2",               $ parameter name
   "Hz",                       $ units string
   "PWM outputs only",         $ help string
   20,2500,45,                 $ minimum, maximum and default values
    , , , , , , , , ;          $ optional fields

Param6=
   0,                          $ reserved
   6, "20 0B 24 2 30 65",      $ link size and path
   0x02,                       $ descriptor
   0xC6, 1,                    $ data type, data size (in bytes)
   "Analog Range 2",           $ parameter name
   "N/A",                      $ units string
   "Analog outputs only ('2' not supported)",       $ help string
   1,5,3,                      $ minimum, maximum and default values
   1,1,1,0,0,0,0,0,0;          $ optional fields

$ -------------------------------------------------------------------------------- $
$                                  CHANNEL 3                                       $
$ -------------------------------------------------------------------------------- $
Param7=
   0,                          $ reserved
   6, "20 0B 24 3 30 3",       $ link size and path
   0x00,                       $ descriptor
   0xD1, 1,                    $ data type, data size (in bytes)
   "Value 3",                  $ parameter name
   "/255",                     $ units string
   "AOP Output Value",         $ help string
   0,255,0,                    $ minimum, maximum and default values
    , , , , , , , , ;          $ optional fields

Param8=
   0,                          $ reserved
   6, "20 0B 24 3 30 64",      $ link size and path
   0x00,                       $ descriptor
   0xC7, 2,                    $ data type, data size (in bytes)
   "PWM Freq 3",               $ parameter name
   "Hz",                       $ units string
   "PWM outputs only",         $ help string
   20,2500,45,                 $ minimum, maximum and default values
    , , , , , , , , ;          $ optional fields
```

```
Param9=
   0,                             $ reserved
   6, "20 0B 24 3 30 65",         $ link size and path
   0x02,                          $ descriptor
   0xC6, 1,                       $ data type, data size (in bytes)
   "Analog Range 3",              $ parameter name
   "N/A",                         $ units string
   "Analog outputs only ('2' not supported)",        $ help string
   1,5,3,                         $ minimum, maximum and default values
    , , , , , , , , ;             $ optional fields

$ ----------------------------------------------------------------------------- $
$                                  CHANNEL 4                                    $
$ ----------------------------------------------------------------------------- $
Param10=
   0,                             $ reserved
   6, "20 0B 24 4 30 3",          $ link size and path
   0x00,                          $ descriptor
   0xD1, 1,                       $ data type, data size (in bytes)
   "Value 4",                     $ parameter name
   "/255",                        $ units string
   "AOP Output Value",            $ help string
   0,255,0,                       $ minimum, maximum and default values
    , , , , , , , , ;             $ optional fields

Param11=
   0,                             $ reserved
   6, "20 0B 24 4 30 64",         $ link size and path
   0x00,                          $ descriptor
   0xC7, 2,                       $ data type, data size (in bytes)
   "PWM Freq 4",                  $ parameter name
   "Hz",                          $ units string
   "PWM outputs only",            $ help string
   20,2500,45,                    $ minimum, maximum and default values
    , , , , , , , , ;             $ optional fields

Param12=
   0,                             $ reserved
   6, "20 0B 24 4 30 65",         $ link size and path
   0x02,                          $ descriptor
   0xC6, 1,                       $ data type, data size (in bytes)
   "Analog Range 4",              $ parameter name
   "N/A",                         $ units string
   "Analog outputs only ('2' not supported)",        $ help string
   1,5,3,                         $ minimum, maximum and default values
    , , , , , , , , ;             $ optional fields

$ ----------------------------------------------------------------------------- $
$                                  CHANNEL 5                                    $
$ ----------------------------------------------------------------------------- $
Param13=
   0,                             $ reserved
   6, "20 0B 24 5 30 3",          $ link size and path
   0x00,                          $ descriptor
   0xD1, 1,                       $ data type, data size (in bytes)
   "Value 5",                     $ parameter name
   "/255",                        $ units string
   "AOP Output Value",            $ help string
   0,255,0,                       $ minimum, maximum and default values
    , , , , , , , , ;             $ optional fields

Param14=
   0,                             $ reserved
   6, "20 0B 24 5 30 64",         $ link size and path
   0x00,                          $ descriptor
   0xC7, 2,                       $ data type, data size (in bytes)
   "PWM Freq 5",                  $ parameter name
   "Hz",                          $ units string
   "PWM outputs only",            $ help string
```

```
   20,2500,45,                  $ minimum, maximum and default values
    , , , , , , , , ;           $ optional fields

Param15=
   0,                           $ reserved
   6, "20 0B 24 5 30 65",       $ link size and path
   0x02,                        $ descriptor
   0xC6, 1,                     $ data type, data size (in bytes)
   "Analog Range 5",            $ parameter name
   "N/A",                       $ units string
   "Analog outputs only ('2' not supported)",       $ help string
   1,5,3,                       $ minimum, maximum and default values
    , , , , , , , , ;           $ optional fields

$ ------------------------------------------------------------------------------ $
$                                  CHANNEL 6                                     $
$ ------------------------------------------------------------------------------ $
Param16=
   0,                           $ reserved
   6, "20 0B 24 6 30 3",        $ link size and path
   0x00,                        $ descriptor
   0xD1, 1,                     $ data type, data size (in bytes)
   "Value 6",                   $ parameter name
   "/255",                      $ units string
   "AOP Output Value",          $ help string
   0,255,0,                     $ minimum, maximum and default values
    , , , , , , , , ;           $ optional fields

Param17=
   0,                           $ reserved
   6, "20 0B 24 6 30 64",       $ link size and path
   0x00,                        $ descriptor
   0xC7, 2,                     $ data type, data size (in bytes)
   "PWM Freq 6",                $ parameter name
   "Hz",                        $ units string
   "PWM outputs only",          $ help string
   20,2500,45,                  $ minimum, maximum and default values
    , , , , , , , , ;           $ optional fields

Param18=
   0,                           $ reserved
   6, "20 0B 24 6 30 65",       $ link size and path
   0x02,                        $ descriptor
   0xC6, 1,                     $ data type, data size (in bytes)
   "Analog Range 6",            $ parameter name
   "N/A",                       $ units string
   "Analog outputs only ('2' not supported)",       $ help string
   1,5,3,                       $ minimum, maximum and default values
    , , , , , , , , ;           $ optional fields

$ ------------------------------------------------------------------------------ $
$                                  CHANNEL 7                                     $
$ ------------------------------------------------------------------------------ $
Param19=
   0,                           $ reserved
   6, "20 0B 24 7 30 3",        $ link size and path
   0x00,                        $ descriptor
   0xD1, 1,                     $ data type, data size (in bytes)
   "Value 7",                   $ parameter name
   "/255",                      $ units string
   "AOP Output Value",          $ help string
   0,255,0,                     $ minimum, maximum and default values
    , , , , , , , , ;           $ optional fields

Param20=
   0,                           $ reserved
   6, "20 0B 24 7 30 64",       $ link size and path
   0x00,                        $ descriptor
   0xC7, 2,                     $ data type, data size (in bytes)
   "PWM Freq 7",                $ parameter name
```

```
      "Hz",                         $ units string
      "PWM outputs only",           $ help string
      20,2500,45,                   $ minimum, maximum and default values
       , , , , , , , , ;            $ optional fields

   Param21=
      0,                            $ reserved
      6, "20 0B 24 7 30 65",        $ link size and path
      0x02,                         $ descriptor
      0xC6, 1,                      $ data type, data size (in bytes)
      "Analog Range 7",             $ parameter name
      "N/A",                        $ units string
      "Analog outputs only ('2' not supported)",        $ help string
      1,5,3,                        $ minimum, maximum and default values
       , , , , , , , , ;            $ optional fields

   $ ------------------------------------------------------------------------------ $
   $                                  CHANNEL 8                                     $
   $ ------------------------------------------------------------------------------ $
   Param22=
      0,                            $ reserved
      6, "20 0B 24 8 30 3",         $ link size and path
      0x00,                         $ descriptor
      0xD1, 1,                      $ data type, data size (in bytes)
      "Value 8",                    $ parameter name
      "/255",                       $ units string
      "AOP Output Value",           $ help string
      0,255,0,                      $ minimum, maximum and default values
       , , , , , , , , ;            $ optional fields

   Param23=
      0,                            $ reserved
      6, "20 0B 24 8 30 64",        $ link size and path
      0x00,                         $ descriptor
      0xC7, 2,                      $ data type, data size (in bytes)
      "PWM Freq 8",                 $ parameter name
      "Hz",                         $ units string
      "PWM outputs only",           $ help string
      20,2500,45,                   $ minimum, maximum and default values
       , , , , , , , , ;            $ optional fields

   Param24=
      0,                            $ reserved
      6, "20 0B 24 8 30 65",        $ link size and path
      0x02,                         $ descriptor
      0xC6, 1,                      $ data type, data size (in bytes)
      "Analog Range 8",             $ parameter name
      "N/A",                        $ units string
      "Analog outputs only ('2' not supported)",        $ help string
      1,5,3,                        $ minimum, maximum and default values
       , , , , , , , , ;            $ optional fields


[EnumPar]
    Param3="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param6="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param9="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param12="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param15="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param18="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param21="0-10V","N/A","-10-10V","0-5V","-5V-5V";
    Param24="0-10V","N/A","-10-10V","0-5V","-5V-5V";


[Groups]
    Group1 = "AOP Object",24,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24;
```

Appendix C: Specifications

DeviceNet Power Supply:

Power Supply Voltage:	8.8 V to 65.0 V, continuous operating
Power Supply Isolation:	1.2kVrms
Current Consumption:	200 mA @ 8.8 V Supply 150 mA @ 11.0 V Supply 80 mA @ 25.0 V Supply
Overvoltage Withstand:	120V, 20 seconds
Operation During Overvoltage:	Module operation maintained without disruption throughout transient
Applicable Military Standard:	Exceeds Quadripartite Standardization Agreement 307, Annex B (28VDC Military Vehicles), including Load-Dump Transient protection.

Aux Power Supply:

Operating Voltage:	Min. 4.5 V Max: 39 V
Operating Current:	Max: 18A sum of all PWM output currents
Reverse Polarity Protection:	Parallel diode
Overvoltage Withstand:	Max. 120V, indefinite duration
Operation During Overvoltage:	Outputs turned off to protect load when Aux. Supply > max. operating voltage
Applicable Military Standard:	Exceeds Quadripartite Standardization Agreement 307, Annex B (28VDC Military Vehicles), including Load-Dump Transient protection.

Pulse Width Modulated (PWM) Outputs:

Output Type:	High-side switched Aux. Power
PWM Frequency:	Min. 20 Hz (extended ranges possible) Max. 2.5 kHz (consult factory)
PWM Frequency Stability:	100 ppm
PWM Resolution:	8 bits
PWM Duty Cycle Range:	0% to 100%
Overvoltage Shutdown:	39.5V – 42V
Undervoltage Shutdown:	2.4V – 4.5V
Operating Current:	Max. 5 A, note: must also consider limit on Aux. Power sum of PWM output currents
Overcurrent Trip Point:	Initial Peak: 7-35 A Repetitive: 6-10 A
Overcurrent Shutdown Delay:	Min. 80 µs Max. 400 µs

Overcurrent Recovery Mode:	Electronic fuse: cycle Aux. Power to reset
Thermal Overload Trip Temp:	Min. 150°C
Inductive Spike Protection:	Output clamped at 42V, 1500W max. pulse
Loss of Ground Protection:	Yes
Loss of Aux. Power Protection:	Yes
Applied External Voltage:	Current will not flow into PWM output
State of Outputs on Power Up:	All outputs off. Outputs do not come on during processor reset or boot-up
DeviceNet State Behaviour:	All outputs immediately turned off any time the module is not in ***Established*** state.

Voltage Outputs:

Selectable Ranges:	0-5V, 0-10V, -5V to +5V, -10V to +10V
Resolution:	8 bit
Output Current:	20 mA (max.)
Short Circuit Protection:	Yes
Reverse Battery Protection:	Yes
Loss of Aux. Power:	Outputs go to 0V
State of Outputs on Power Up:	Voltage out = 0V. Outputs do not come on during processor reset or boot-up
DeviceNet State Behaviour:	All outputs immediately go to 0V any time the module is not in ***Established*** state.

Communications:

Data Rates Supported:	125 kbps, 250 kbps, 500 kbps	
Maximum Distances:	500 m (1,640 ft)	at 125 kbps
	200 m (650 ft)	at 250 kbps
	100 m (330 ft)	at 500 kbps

Electromagnetic Interference Control:

Emissions:	Meets MIL-STD 461D: RE102, Navy Mobile and Army
Susceptibility:	Meets MIL-STD 461D: RS103, Ground Vehicles

Note: Only –SSE enclosure option is qualified to MIL-STD 461D EMI Limits

Environmental

Operating Temperature:	-40°C to +85°C
Storage Temperature:	-55°C to +125°C

Shipping Configuration:

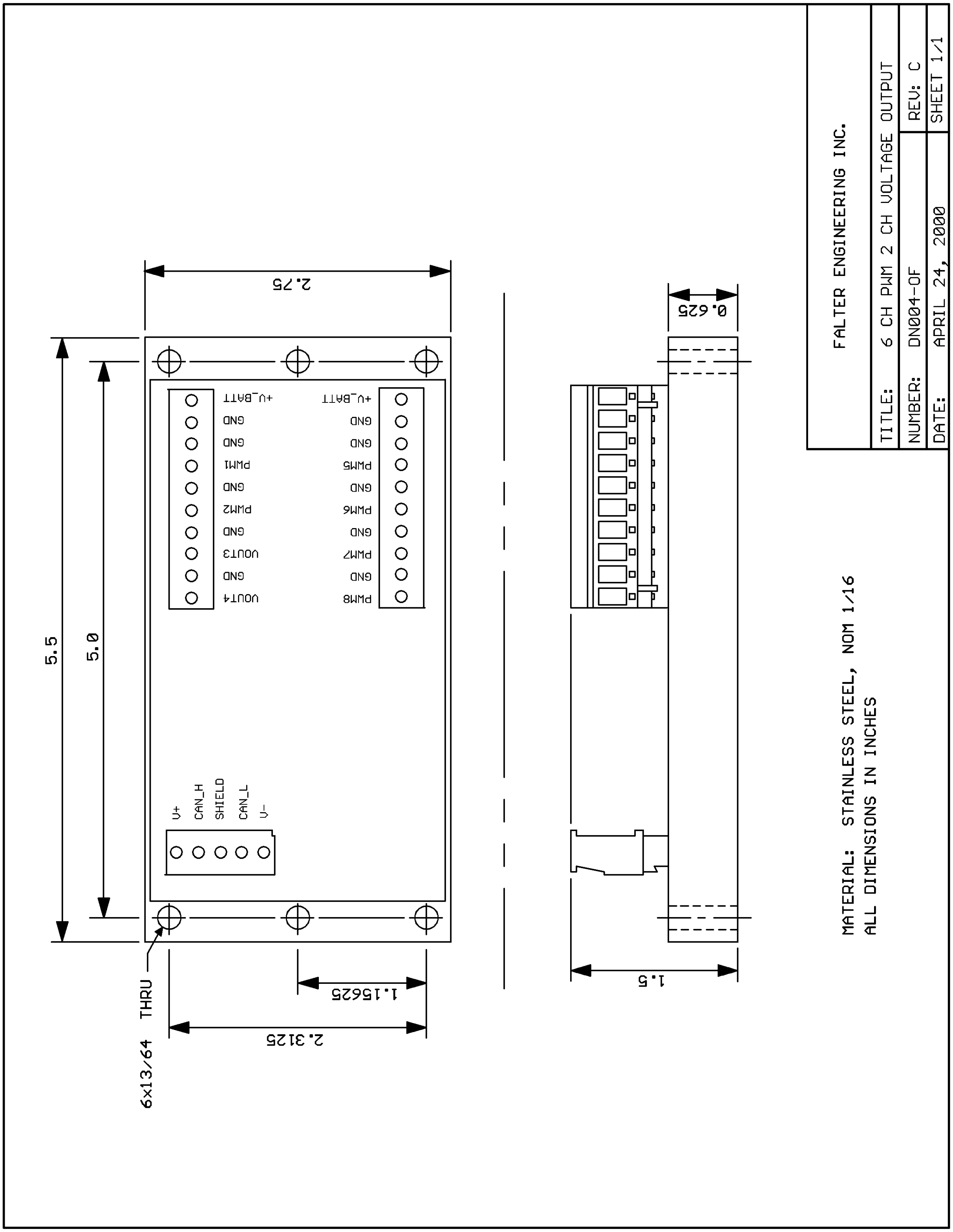
MAC ID:	63
Data Rate:	125 kbps
PWM Frequency:	45 Hz Note: will be shipped with customer

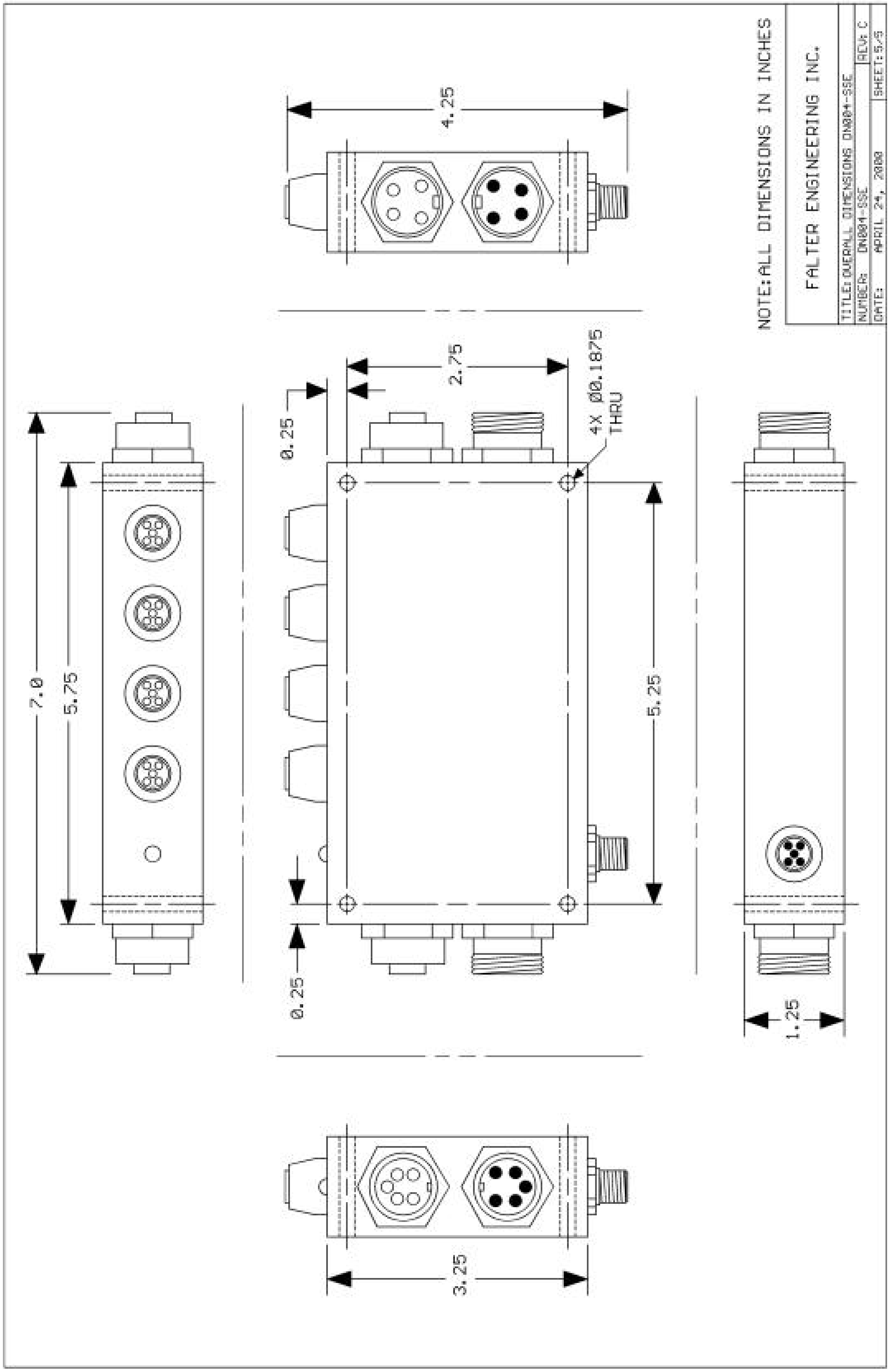
requested configuration if specified in order

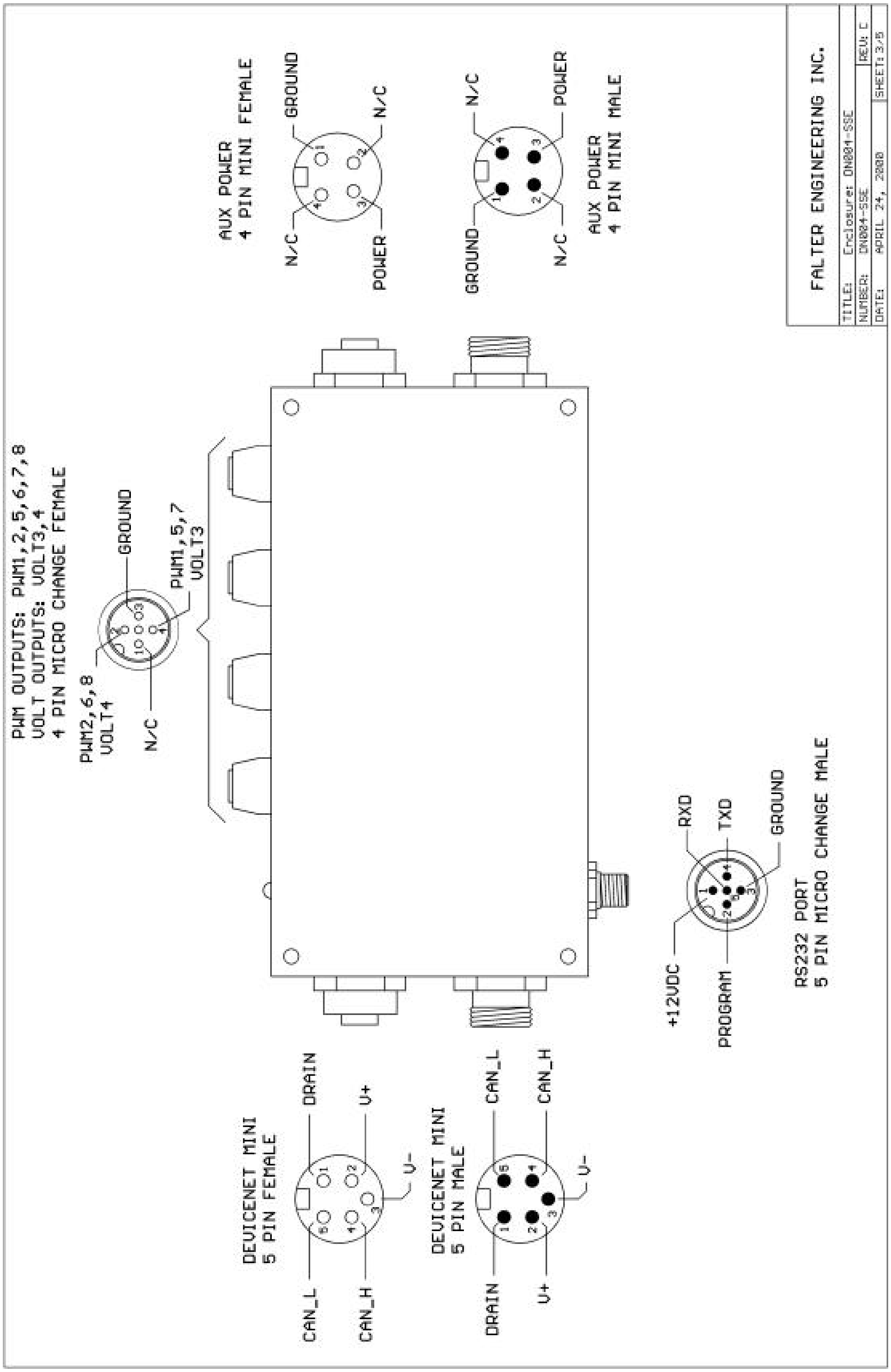
Ordering Information

DN004-OF	Potted into Open Frame stainless steel tray, Terminal block connectors
DN004-SSE	Potted into Stainless Steel Enclosure, sealed stainless steel Mini-style DeviceNet and Aux. connectors, sealed stainless steel micro-style connectors for outputs

Appendix D: Mechanical Drawings




NOTE: ALL DIMENSIONS IN INCHES
FALTER ENGINEERING INC.
TITLE: OVERALL DIMENSIONS DN004-SSE
NUMBER: DN004-SSE
DATE: APRIL 24, 2000
REV: C
SHEET: 5/5
4.25
2.75
0.25
4X Ø0.1875 THRU
7.0
5.75
5.25
0.25
1.25
3.25


PWM OUTPUTS: PWM1,2,5,6,7,8
VOLT OUTPUTS: VOLT3,4
4 PIN MICRO CHANGE FEMALE
PWM2,6,8
VOLT4
N/C
GROUND
PWM1,5,7
VOLT3
AUX POWER
4 PIN MINI FEMALE
N/C
GROUND
N/C
POWER
GROUND
N/C
POWER
N/C
AUX POWER
4 PIN MINI MALE
DEVICENET MINI
5 PIN FEMALE
CAN_L
CAN_H
DRAIN
V+
V-
DEVICENET MINI
5 PIN MALE
DRAIN
V+
CAN_L
CAN_H
V-
+12VDC
PROGRAM
RXD
TXD
GROUND
RS232 PORT
5 PIN MICRO CHANGE MALE
FALTER ENGINEERING INC.
TITLE: Enclosure: DN004-SSE
NUMBER: DN004-SSE
REV: C
DATE: APRIL 24, 2000
SHEET: 3/5